Tech Talk: 'Blue box' helps engineers turn crash results into safer cars

http://detnews.com/1998/motorsports/9803/16/03170006.htm

By Bruce McLaughlan / The Detroit News

When a plane crashes, the first thing safety experts look for is the data-recording "black box." When an open-wheeled CART race car slams a wall, safety experts seek out the "blue box" -- as in Ford blue -- an armored instrument that records the intensity, direction and duration of the impact, measured in g-forces.

The box is part of a joint effort between Ford Special Vehicle Operations Technologies and CART to make cars safer on the race track, and on the street. Based on results so far, CART has put more foam padding higher around its drivers' heads and made its carbon fiber panels thicker. They've also convinced drivers that tight seat belts are safer than loose ones.

The idea is to let the cars, not the driver, absorb, spread and dampen the impact forces.

Engineers at Ford use the g-forces experienced by CART drivers to refine computer programs that can predict just what will happen in a crash. Previously, they mainly relied on test dummies and cadavers for data, but there's no substitute for live humans.
And, notes program manager Paul Stanecki, "Nowhere else in the world can you get guys to volunteer" to ram cars into concrete walls at more than 100 mph.

The key factor in survivability, Stanecki said, is a combination of impact intensity and duration. "The body has to have a high-g and high duration to be hurt," he said.

Jet fighter pilots can black out in 10g turns if the force continues more than a few seconds. But in a crash at Fontana, Calif., last year, Arie Luyendyk survived a brief moment where forces exceeded 110g.

CART's most violent accidents tend to be brief, Stanecki said, typically a single car ramming a wall, followed by a long energy-dissipating slide. In NASCAR, where more unpredictable forces are at work, you're more likely to see a car go airborne and cartwheel down the track, hitting other cars along the way.

To use the data in designing passenger car safety systems, Ford engineers had to figure out how the average CART driver compares with the average commuter.

"For the most part, the two groups are identical, with two exceptions: CART drivers have a significantly longer foot length, and broader shoulders," Stanecki said. How it works:

* Every CART race car has one of the boxes mounted in the cockpit just below the driver's legs.

* Instruments continually record forces on the car. When they exceed 10g, it triggers a permanent 2-second recording, pulling the half-second before impact from memory. Normal non-crash forces peak at 3g under heaviest braking. (In Formula One, braking can subject a driver to as much as 4g.)

* The information is downloaded at the scene into a portable computer via a connector mounted near the dashboard.

* In addition to the blue box data, experts analyze TV film of the incident, pictures of the debris field and reports from the track corner workers and medical crew. They also examine the driver's helmet for paint marks that will show where it hit bodywork.

* All the data about the impact and resulting injuries are used to fine-tune three-dimensional computer models in which engineers can simulate crashing cars over and over, without having to pick up the pieces afterward. The program has been revised with six months of data from last year's racing season -- 75 incidents in all. "By the end of the year, we had very high assurances that our model was bridging the gap between theory and reality," Stanecki said.

* Ford shares its crash data with General Motors, which has a similar program with the Indy Racing League.

Bruce McLaughlan writes the weekly Bench Racing column for Detroit News Online.

 Monday, March 16, 1998